Revisiting forestry's crystal ball[1]

by Winifred B. Kessler[2]

ABSTRACT

This paper revisits 3 broad predictions about forestry's future presented by the author in 1993: the growing importance of products that come from forests, forests increasingly valued for more than the sum of their products and uses, and better appreciation of forests as complex ecological systems controlled by forces larger than humans. These predictions have played out in more dramatic ways than initially envisioned, driven in part by 3 emergent forces: the energy crisis, the ascension of new economic superpowers, and climate change. Examples of these trends and relationships are examined from Canadian and United States contexts.

Key words: ecosystem services, forests and climate change, forests and global warming, forest biofuels, forest management trends, sustainable forestry

RÉSUMÉ

Cet article révise trois prédictions générales portant sur l'avenir de la foresterie présentées par l'auteur en 1993 : l'importance croissante des produits issus des forêts, l'accroissement de la valeur des forêts pour la somme des produits et des utilisations qu'on en retire et une meilleure appréciation des forêts en tant systèmes écologiques complexes contrôlés par des forces plus importantes que les humains. Ces prédictions ont joué un rôle plus dramatique que prévu initialement en partie à cause des effets engendrés par trois forces émergentes : la crise de l'énergie, l'ascension de nouvelles superpuissances économiques et les changements climatiques. Des exemples des ces tendances et des ces relations sont tirés du contexte canadien et étatsunien.

Mots clés : services tirés des écosystèmes, forêts et changements climatiques, forêts et réchauffement planétaire, biocarburants forestiers, tendances en aménagement forestier, foresterie durable

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Introduction

In September 1993 I arrived at the construction site that would become the main campus of the University of Northern British Columbia (UNBC) in Prince George, British Columbia. My new job was to chair the Forestry Program within an interdisciplinary Faculty of Natural Resources and Environmental Studies. Since neither the program nor the faculty existed yet, the first order of business was to build them from the ground up. It was a huge challenge and a great deal of work, but it remains the undisputed high point of my career.

During those early days at UNBC, we seemed to have unlimited opportunity to get up on our stumps and talk about forest ecology and management. The north's appetite for ideas, research findings, and practical information relating to forestry seemed insatiable. One of my first invitations to speak as the new UNBC Forestry Chair came the month after I arrived. It was a conference in Prince George hosted by Canfor, and my assigned topic was "What I See in Forestry's Crystal Ball." The topic gave me license to examine trends and to speculate on what they might mean for the future of forestry.

Fast forward 15 years, when I was invited back to Prince George to speak again, this time as the 2008 Doug Little Lecturer. In choosing a topic, I got the idea of revisiting the 1993 vision in the crystal ball to see how my predictions had fared.

The Doug Little Memorial Lecture

The Doug Little Memorial Lecture series was initiated by the Faculty of Natural Resources and Environmental Studies at the University of Northern British Columbia (UNBC) in 1996. This annual event commemorates the late J.D. Little, former Senior Vice-President of Forest Operations, Northwood Pulp and Timber Limited. Doug was a founding supporter of UNBC and a recipient in 1986 of the Distinguished Forester Award from the Association of British Columbia Professional Foresters. Doug Little believed that with appropriate forest management, the resources of the forest could be sustained for future generations. That philosophy is the central theme of this lecture series, supported by an endowment from Northwood Pulp and Timber Limited.

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I dug into the file cabinet and found a dusty copy of that talk from 15 years ago. This provided the basis for an interesting round of retrospection on the past, and reflection on the path ahead.

The View From 1993

My 1993 lecture began by describing 2 broad forces that I believed to be important shapers of forestry's future. The first was a human population that continues to increase exponentially on a finite planet. I made the point that worldwide, lands and natural resources are getting scarcer, more stressed, and more precious to the people who must share them.

The second force was a fundamental change in thinking about what imposes limits to growth. The traditional view held that resource supplies are what limit growth, and the solution was to boost productivity through science and technology. By 1993, however, there were strong indications that resource supplies may not be the answer after all. Increasingly, the limits to growth reflected the ability of the planet's ecological systems to tolerate the stresses placed upon them by a growing and consuming human population. Polluted water and air, degraded soils, and diminishing biodiversity were symptoms of those stresses. The paradigm for natural resources management shifted from maximum yields to sustainability. The new emphasis on sustainable ecosystems, economies, and social systems was evident in such policy developments as the *Canada Forests Accord*, through which the provinces and stakeholders committed to principles of sustainability.

In light of those shaping forces, I made 3 predictions about forestry's future: 1) The importance of products that come from forests will increase. 2) Increasingly, forests will be valued for more than the sum of their products and uses. 3) There will be better appreciation of forests as complex ecological systems, controlled by forces bigger than we humans.

In revisiting those predictions, I discovered that all have come about, but in wildly more spectacular ways than I dreamed of in 1993.

The View Today

Certain new forces, unseen in my crystal ball of 1993, are shaping forestry's present and future in powerful ways. The first of these is the energy crisis, especially relating to oil. It seems only yesterday that peak oil production was still years or decades ahead. Then suddenly, most experts say it is right around the corner and some even suggest it may be behind us. Globally, we are facing diminishing supplies and fluctuating prices and this changes the economics of everything, including forestry.

Second is the emergence of new economic superpowers. It seems only yesterday that China and India were impoverished countries struggling to meet the basic needs of their large human populations. Then suddenly, they are rising economic stars with voracious appetites for modern cities, cars, highways, and all the materials and fuels needed to support those demands. It's not just about population growth anymore; it's also about the changing consumption rates and patterns of those populations.

Third is climate change. It seems only yesterday that this was a theory that, if correct, might affect future generations. Then suddenly, the permafrost is melting, the forests are burning, and there's no stopping the beetles.

Moreover, these shaping forces interact in various ways, which adds both complication and interest to the mix. With that in mind, let's now examine how each prediction is playing out under the new combination of shaping forces.

Prediction 1: The Importance of Products that Come from Forests Will Increase

This prediction has taken some dramatic turns in recent years, driven largely by the energy and climate change issues. In 1993, the growing emphasis on sustainability meant that industry and consumers were starting to appreciate wood as a "green" material. Also, there was growing recognition that considering only the production and delivery aspects of materials was inadequate. Rather, the entire life cycle needs to be considered when calculating the environmental footprint of wood and alternative materials.

Today, wood is increasingly valued for its potential roles in reducing greenhouse gases, a key factor in global warming. For example, studies by Lippke and Edmonds (2006) compared the global warming potential (measured as kilograms of CO_2 released) of materials used in residential construction. Their analysis of floor materials found that the global warming potential (GWP) of concrete slabs and of steel joists was 454% and 731% higher, respectively, than joists made from wood. Their analysis of wall framing materials for a wintry climate (Minneapolis) found that steel-stud walls had 44% higher GWP than kiln-dried wood walls; even greater GWP reductions (75%) resulted by substituting wood siding for vinyl siding, wood paneling for gypsum, cellulose for fibreglass, and increasing the use of biofuels for drying.

The increased interest in materials substitution for environmental gains has spurred parallel developments in the certification arena. The Leadership in Energy and Environmental Design (LEED) system for green rating was initiated in 1998 by the U.S. Green Building Council, which had its own origins in 1993. LEED is a third-party certification program based on standards for the design, construction, and operation of environmentally sustainable buildings. And because wood is only "green" if it comes from forests managed in an ecologically sustainable and socially responsible manner, the past 15 years have also seen the evolution of the forest certification industry with such major players as the Forest Stewardship Council, Sustainable Forestry Initiative (SFI®), and the Canadian Forest Standards Association.

How else are the products that come from forests increasing in value? In addition to helping prevent greenhouse gas emissions through materials substitution, forests have increasingly significant roles through biomass substitution. These uses of forest biomass were just appearing on the radar screen in 1993. In my speech that year, I described how Nordic countries were turning to their forests as a way to reduce dependence on nuclear energy. Their basic idea was to burn waste wood to produce heat and power on industrial scales. Think of pellet stoves on steroids! British Columbia mills at that time were phasing out their teepee burners, and some were considering co-generation facilities as a way to make use of wood waste.

In recent years, the twin issues of climate change and energy have greatly increased interest in the substitution of biomass for fossil fuels. Biomass in the United States is, at 48%, the country's largest domestic source of renewable energy; of this about 65% comes from wood (Malmsheimer *et* *al.* 2008). While only 3% of U.S. energy needs are now fuelled by wood, Zerbe (2006) estimates that this could increase to 10%. Of course the Swedes might say "big whoop," as they are already at the 25% mark (http://bioenergy.checkbiotech.org/news/forest_biomass_sweden_efficient_fuel_long_distance_exports_cost_effective).

The interest in obtaining heat from biomass has spurred development of new products such as Biobricks™ created by BioPellet Heating Systems LLC to "provide customers with highly efficient, low operating cost, environmentally friendly heating systems and locally made renewable fuel" (http://www.biopellet.net/aboutus.html). It has also led to new initiatives such as the Fuels for Schools Program, which originated in Vermont and spread to many other rural areas where woody material is abundant and school funding tight. Implemented as partnership projects between the U.S. Forest Service, state agencies, and local governments, the Fuels for Schools mission is to promote and encourage the use of wood biomass as a renewable natural resource for heating and powering buildings while facilitating the removal of hazardous fuels from forests (McElroy 2007).

In addition to direct combustion for heat or power, biomass can be converted to biofuels through a variety of processes. Already in the pulp and paper industry, hemicellulose from wood is being converted by hydrolysis and fermentation into ethanol and other fuels. Heating wood with little or no oxygen (pyrolysis) can produce liquid and gas fuels, and treatment with oxygen and heat (gasification) can produce synthetic gas (syngas) from wood. Biofuels from wood can help relieve the fuels crunch in ways that also help with the climate change problem. A study by the U.S. Environmental Protection Agency (2007) compared the greenhouse gas emissions of a range of alternative and renewable fuels to petroleum fuel. Results indicated that every BTU of gasoline replaced by cellulosic ethanol would achieve a total life-cycle reduction in greenhouse gas emissions of 90.9%.

Biofuels from wood offer additional advantages from the environmental and social perspectives. Their production does not use a food source that humans need, such as corn; does not tie up prime agricultural lands; and, often has companion benefits of reducing hazardous fuels from the forest.

Prediction 2: Increasingly, Forests Will be Valued for More than the Sum of Their Products and Uses

In 1993, there was growing recognition that forests are not just producers of goods and places to recreate. In addition, they perform a variety of services such as filtering and storing water, fixing nitrogen, and protecting the soil. Traditionally those services were treated as "freebies," when actually they have tremendous economic values.

This prediction has come to pass in several ways. First, there have been rigorous attempts to identify and quantify those ecosystem services, with eye-opening results. In one of the most comprehensive studies, a team of ecological economists estimated the value of the world's ecosystem services and natural capital (Costanza *et al.* 1997). They performed economic analyses for 16 biomes, estimating what it would cost to provide humanity with 17 essential services now provided by ecosystems. They considered such services as climate regulation, water regulation, water supply, nutrient cycling, soil formation, waste treatment, biological control, and others. The estimated economic value ranged $16- to $54 trillion US per year, with an average of $33 trillion that the authors considered to be a minimum estimate. For comparison, consider that the global estimate of gross national product is around $18 trillion.

Scaling down to a regional level, a study by The Wilderness Society sought to place dollar values on the full range of assets and services provided by the national forests in Alaska (Phillips *et al.* 2008). They used direct estimation and benefit transfer methodology to estimate the value of direct uses such as recreation and tourism, community benefits such as visitor spending and subsistence harvest, off-site uses such as commercial salmon fishing, scientific uses, and ecological services. Their finding that the 2 national forests in Alaska supply $2.6- to $2.9 billion US per year, over and above commodity production (timber and mining), paints a very different economic picture than conventional economic analysis that only considers commodity values.

How else is this prediction playing out? Increasingly, forests are valued because of their highly significant roles in preventing, reducing, and mitigating the greenhouse gas emissions that contribute to global warming. Simply by existing, forests store large amounts of carbon in their trees, understory vegetation, and soils. Studies completed for the Canadian Boreal Initiative (http://www.borealcanada.ca/research-cbi-reports-e.php) estimated that more than 186 billion tonnes of carbon are stored in the trees, soils, water, and peat of Canada's boreal forest. This is equivalent to about 913 year's worth of greenhouse gas emissions in Canada The ecosystem services provided by the boreal forest, such as carbon storage and water filtration, have an estimated value 13.8 times that of the conventional commodities (timber and minerals).

Since the 1960s, ecologists assumed that old-growth forests do not have a significant role in carbon storage. That assumption explains why ancient forests were not included in the Kyoto protocol; however, that assumption was wrong. An international team from the Laboratory of Climate and Environmental Science (France) found that ancient forests fix 0.8- to 1.8 billion tonnes of carbon each year, which accounts for at least 10% of all carbon sinking activity worldwide (Luyssaert *et al.* 2008).

What about managed forests; do they have a significant role in sequestering carbon? The answer is, "that depends!" While some studies have found that managed forests can sequester more carbon than unmanaged forests, the factors that figure in are numerous and complex. The good news is that the performance of managed forests in sequestering carbon can be enhanced by product substitution, product diversification, recycling, and other practices. Malmsheimer (2008) summarized studies that modeled carbon over multiple forest rotations. Results showed that the carbon storage performance of managed forests is influenced by the fate of the wood produced; for example, how wood waste is disposed of and whether wood substitutes for other building materials.

Another great thing about forests is that they can perform these important functional roles (carbon sequestration, ecosystem services) while simultaneously providing many other benefits to people. My 1993 talk was influenced by recent experiences in India, Mongolia, and rural Siberia, where I came to appreciate the importance of a full range of forest produce in supporting rural livelihoods. Everything from fuelwood and animal fodder to tree sap and medicinal plants contributed to the basic sustenance of rural people.

This was reinforced back home in British Columbia, where pine mushrooms were contributing substantially to family incomes in the Nass Valley, and bark of the Pacific yew tree had been found to have powerful cancer-fighting properties.

Since then, the accounting of these rural survival values has become more quantitative. According to the World Bank's Forest Strategy (http://www.worldbank.org), around 350 million people live within or on the margins of forests and largely depend on those forests for subsistence and income. This includes about 60 million indigenous people almost wholly dependent on these resources. Vedeld *et al.* (2006) did a meta-analysis of 51 case studies from 17 countries in order to quantify how important forests are in providing "forest environmental income" to rural people. They found that the main sources of environmental income—fuelwood, wild animal and plant foods, and fodder for livestock—on average contributed about 22% to mean total household income. While dependence levels were variable, even small contributions were critical to families living near the survival line. The authors concluded that the omission of forest environmental income from poverty assessments and rural economic analyses may lead to flawed policies and interventions.

Clearly, there has been an increase in the ways that forests are valued and improvement in the methods of evaluation. However, that trend would not mean much without changes in industry practices to take those values into account. Another important development is the growth and maturation of forest certification programs. In 1993 these were at the idea stage. The next decade saw a flurry of different certification schemes, but eventually 2 dominated in North America: the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI®). Canada has been a leader in forest certification from the beginning and most companies have at least one, and often multiple, certifications.

Each program is based on a standard that sets objectives and performance measures for the conduct of forest practices, for protecting soil, water, and biological diversity; for supporting research, and so on. Company compliance is determined by independent auditors. Early on, sceptics questioned whether Joe or Jane consumer would choose to pay more, say for a hammer at Home Depot, just because it was stamped as certified. As it turned out, success largely depended on corporate customers rather than retail consumers. For example, many publishing companies choose certified paper sources because projecting an image of environmental responsibility is critical to their economic bottom line.

I need to discuss one more way in which this prediction has come to pass, as evidenced by a significant and troubling trend in the U.S. where forest lands are increasingly valued as real estate investments. Since the mid-1980s many vertically integrated forest products companies have sold off their lands or restructured to legally separate ownership of land and timber from ownership of manufacturing facilities. These include the large companies such as Weyerhauser, Mead Westvaco, Georgia Pacific, and others that owned both forest lands and processing facilities. Lands that are sold go to timber investment management organizations (TIMOs), which manage and sell land and timber on behalf of investors such as insurance companies, pension funds, and so on. When companies are restructured, the land and timber is held by real estate investment trusts (REITs) that manage and sell real estate or related assets (e.g., mortgages) on behalf of private investors. This change in ownership has been huge. Forest land ownership by vertically integrated forest products companies in the U.S. dropped roughly 60% between 1980 and 2005 (Hickman 2007).

The big question is: what is the fate of these forests? When forest companies owned these lands, they managed them for the long haul. Decades might be required between rotations, but forests were managed for long-term productivity. Now the objective is to bring investors the best economic returns on their real estate holdings. The jury is out on how long REITs and TIMOs will hold on to these investments, and whether the lands will continue to support forests.

Prediction 3: There Will be Better Appreciation of Forests as Complex Ecological Systems Controlled by Forces Bigger than We Humans

In my 1993 talk, this prediction addressed the illusion of trying to manage forests as if we were truly in control of everything. I provided examples of various problems and unintended consequences that result when planning and management fail to take natural disturbances such as wildfires, insect outbreaks, floods, and windstorms into account. Of the 3 predictions, this one gets the prize for under-statement. The idea was right, only the scale was off by a few orders of magnitude! I was considering stand-level change, but today the changes beyond our control are operating at the ecosystem level and greater.

The changes associated with a warming climate are massive and profound. This is all too familiar here in British Columbia, where warming temperatures have changed the biology of the mountain pine beetle and facilitated its spread across enormous areas of the province. Where I currently work in southeast Alaska, researchers completed an ingenious set of analyses and experiments that enabled them to conclude that warming temperatures are causing the widespread decline of yellow-cedar.

In many regions of the U.S., past management exacerbated by climate change has created an enormous wildfire problem. Fire suppression now consumes about half of my agency's annual budget, whereas a few years ago it averaged 15%. But burgeoning costs are not the worst thing. In the past year, 22 of our employees and contractors lost their lives while fighting wildfires. If time allowed, we could talk about the hurricanes that have flattened entire forests in the southeastern U.S., or any number of forest insect and disease epidemics.

Ecosystems are changing. Not only the trees, but also the understory vegetation, wetlands, wildlife, hydrology, soil organisms, and all other components are affected. What does this portend for the view in the crystal ball? We must fundamentally rethink what we need to manage for. Practical frames of reference, such as existing vegetation or habitat types or historical ranges of variation, rest on assumptions about the stability or predictable variation of environmental conditions. Those assumptions will not hold in the face of rapid environmental change. Forests must adapt to a different range of environmental conditions, and to do so, our management must adapt as well.

That is why adapting to climate change is a prominent theme in British Columbia's Future Forest Ecosystems Initiative (British Columbia Ministry of Forests and Range 2008). My agency, the U.S. Forest Service, also has a strategic framework for responding to climate change with "assisted adaptation" as a fundamental concept (U.S. Forest Service 2008). We require not only a sustainable vision for forestry's future, but as well an adaptable vision.

Closing Comments

The forces acting on forestry today, and their various interactions, create many uncertainties for the future. This makes for a fuzzy view in the crystal ball that is unlikely to clear up any time soon. The challenges for scientists, managers, and policy-makers have never been greater. And the stakes have never been higher.

My visits with UNBC students in the past 2 days have brought new concerns to my attention. Students report that they are being advised by neighbours, relatives, and friends that "forestry is dead" in British Columbia and there is no future in this profession. Do they really think this? If so, their view is short-sighted in the extreme! Just who do they think is going to restore the forests and assist their adaptation to a changing environment?

As always, forests are integral to British Columbia's economy, ecology, culture, its place in the world, and its future. The predictions about forests increasing in value are more valid than ever, for a wider variety of reasons. The management challenges are unprecedented; it will require the best in science, policy, creative imagination, and professional commitment to restore and sustain forests in the face of unprecedented change. One thing in the crystal ball is absolutely clear, and that is the need for skilled and committed foresters, scientists, and natural resource professionals of all kinds.

References

British Columbia Ministry of Forests and Range. 2008. Future forest ecosystems initiative 2007/08–2009/10 strategic plan. Available at http://www.for.gov.bc.ca/hts/Future_Forests/.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M.van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253–260.

Hickman, C. 2007. TIMOs and REITs. Available at www.timbertax.org/publications/FS/TIMO_REIT_Paper_PDC.pdf .

Lippke, B. and L. Edmonds. 2006. Environmental performance improvements in residential construction: The impact of products, biofuels, and processes. Forest Products Journal 56(10): 58–63.

Luyssaert, S., E.D. Schulze, A. Börner, A. Knohl, D. Hessenmöller, B.E. Law, P. Ciais and J. Grace. 2008. Old-growth forests as global carbon sinks. Nature 455: 213–215.

Malmsheimer, R.W., P. Heffernan, S. Brink, D.Crandall, F. Deneke, C. Galik, E. Gee, J.A. Helms, N. McClure, M. Mortimer, S. Ruddell, M. Smith and J. Steward. 2008. Forest management solutions for mitigating climate change in the United States. Journal of Forestry 106(3): 115–171.

McElroy, A.K. 2007. Fuels for schools and beyond. Biomass Magazine, April 2007. Available at http://www.biomassmagazine.com/article.jsp?article_id=1230.

Phillips, S., R. Silverman and A. Gore. 2008. Greater Than Zero: Toward the total economic value of Alaska's national forest wildlands. The Wilderness Society, Washington, DC.

U.S. Environmental Protection Agency. 2007. Greenhouse gas impacts of expanded renewable and alternative fuels use. EPA 420-F-07-035. Office of Transportation and Air Quality, Washington, DC.

U.S. Forest Service. 2008. Forest Service strategic framework for responding to climate change, version 1. Available at http://www.fs.fed.us/climatechange/documents/strategic-framework-climate-change-1-0.pdf.

Vedeld, P., A. Angelsen, J. Bojö, E. Sjaastad and G.K. Berg. 2006. Forest environmental incomes and the rural poor. Forest Policy and Economics 9(7): 869–879.

Zerbe, J.I. 2006. Thermal energy, electricity, and transportation fuels from wood. Forest Products Journal 56(1): 6–14.